

Sir James Mackenzie (1853–1925): views on general practice education and research

Robert Moorhead MB FRACGP

J R Soc Med 1999;92:38–43

James Mackenzie (Figure 1) was a visionary Scottish general practitioner who received international acclaim for his research into rhythms of the heart. He firmly believed in the importance of basing medical education in the community and the value of observation of patients in general practice for research.

Mackenzie was born in 1853, the third child of a highland farmer, at Pickston Hill near Scone, Perthshire. Macbeth's woods of Birnham and Dunsinane lay to the north and east of the farm. Times were tough for a farmer in the 1870s yet the Mackenzies managed to send all three children to Edinburgh University (with a bag of oatmeal each). Credit goes to the progressive farming methods used by his father as well as his industriousness plus the inspiration of his mother. His brother wrote of her:

'... she was the mainstay of the family. She had a strong, indomitable spirit, and when things were going badly on the farm it was her noble soul that rose above difficulties and trials. She was also the unostentatious and generous helper of the poor of the village, and all in distress came to her for her assistance and comfort.'

James owed much to his parents, and his mother's influence endured throughout his life¹.

CHILDHOOD LEARNING

Mackenzie demonstrated at an early age that he was a reasoner. Brought up in a strong Presbyterian family he used to have difficulty in memorizing the shorter catechism and often argued about this with his father (an elder in the Kirk). He reminded his father of St Paul's words, 'I had rather speak five words with my understanding than ten thousand words in an unknown tongue' (*1 Corinthians* 14, verse 19)¹. Looking back at his early education—the local parish school and the academy at Perth—he said:

'... the things that I remember most clearly about my school education were that I was considered a dunce at

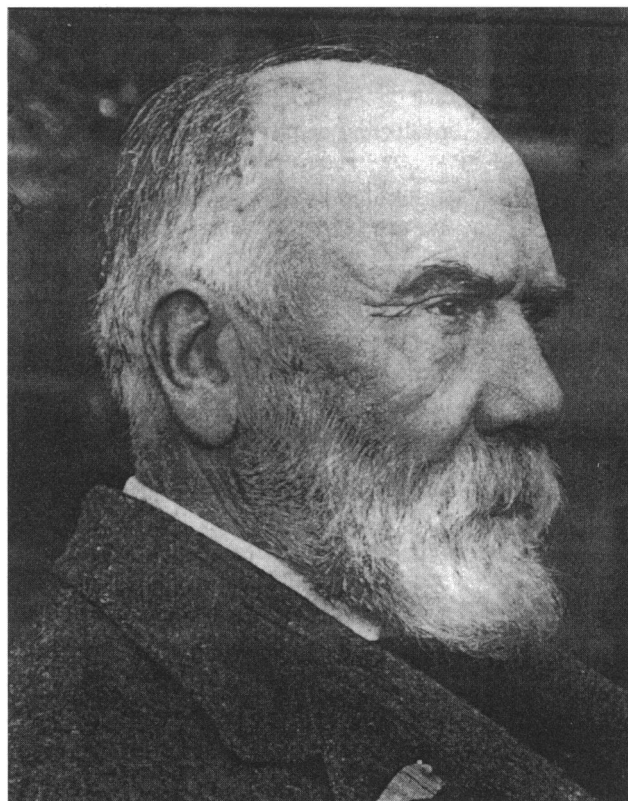


Figure 1 Sir James Mackenzie, aged about 70

most of my classes, and that the subjects in which I did well were those in which my understanding rather than my memory was called into play².

Mackenzie left school at 15 at his own request and began his working life apprenticed to a Perth chemist. He worked 80 hours a week on an annual stipend of £5. His limited leisure hours were spent reading Scott, Smollett, Fielding, Dickens, Thackeray, Huxley, Darwin and Tyndal².

THE UNDERGRADUATE

He began medicine at 21 at Edinburgh University and scraped through the scientific years only by hard work and committing long passages from lectures to memory (on many occasions not understanding what he was memorizing). However, he delighted in the later clinical years and

won three medals. His reflections on a medical education are similar to his earlier thoughts on his schooling:

'...examinations are specially contrived for the purposes of discriminating those with the best memories, and to them all the honours and prizes are given... the individuals who, on the contrary possess more of the power of reasoning than their fellows, receive no consideration².'

Mackenzie had a 'reflector' learning style³ since he preferred to think about data thoroughly before coming to a conclusion. He later demonstrated his ability to theorize about arterial and venous pulse waves. This learning style is said to resemble that of current British general practitioner trainers⁴. If he were alive today he would probably be an advocate for problem-solving case work for medical undergraduates since this approach is thought to produce graduates with strong analytic and communication skills⁵.

While at Edinburgh University he studied surgery under Joseph Lister who was among the first to grasp the importance of Pasteur's work. Mackenzie headed his notes on one of Professor Lister's lectures on bacteria and wound sepsis with an elaborately pencilled 'germs again'¹. He foresaw the excesses of reductionist medicine and in an address concerning the defects of medical education said later in his career:

'... again the microbic theory of disease has distracted people from the scientific theory of symptoms. There is less and less ability to draw deductions from the use of the unaided senses. Much research is carried out in laboratories, apart from the patient, or in hospital wards on patients who have long been ill. Patients must be studied in association with their natural environment and the stresses and strains of real life¹⁰.'

Later Mackenzie reflected on his undergraduate training and predicted the future role of the general practitioner academic:

'There is an important idea which has been omitted in the consideration of medical education, namely that a teacher of *practical matters must be one who has experienced what he teaches*. We all recognise that the best teacher for a youth who wants to be a shoemaker is a man who is in the habit of making shoes. If he wants to be a chemist, he goes to a teacher who has a practical knowledge of chemistry. That idea in relation to these subjects will be accepted universally. Unfortunately this commonsense idea is rarely applied to medical education. The vast majority of students who enter on the study of medicine ultimately become general practitioners, and yet a student

may pass through his curriculum and be instructed for years by a large number of teachers, not one of whom has had any experience of the life he is to lead as a general practitioner. As a result a large portion of the student's time and energy has been spent in acquiring information that is of no use to him in the practice of his profession, while much of the knowledge which he often finds essential has never been given to him⁹.'

Mackenzie later resumed his criticism of medical education and the wholesale adoption of the reductionist model of medicine that was to characterize most western universities in the 20th century. He repeated that 'Medicine is taught by specialists; the problems of general practice are not carefully investigated and the general practitioner has no opportunity to teach from his experience'⁸. The money from Mackenzie's estate helped to correct this as it was used to help found the first chair of general practice in the world, at Edinburgh University in 1963⁹. On the curriculum he said, 'Much of the teaching in medical schools deals with rare or established conditions of disease. Many of the ailments with which the general practitioner is confronted are looked on in hospital practice as too trivial to deserve consideration'¹⁰.

Mackenzie continued to criticize the composition of his medical curriculum by saying of the student:

'If we turn to the consideration of the subjects he is taught, it will speedily be realised how much of his time and labour are spent profitably. In his training he is taught a variety of subjects which tradition has imposed upon the teaching world as being necessary to his education, such as botany, zoology and chemistry. It may be said that a knowledge of these subjects is necessary to enable him to understand and appreciate the facts in his other studies, such as physiology and clinical medicine. Admitting this is true, how much is necessary for this purpose? The teachers are men skilled in their particular subject, but have little knowledge of what part of their subject is necessary and what part is immaterial to one who does not intend to become a botanist, a zoologist or a chemist, but a practitioner of medicine. Seeing that these subjects are of a vast extent, and that the medical student can only acquire a knowledge of a small part, it is not unreasonable to expect that his instruction should be limited to that portion which will be of real use to him in his studies and in the practice of his profession.'

In the same vein Mackenzie argued:

'Anatomical books and teachers of anatomy give as much or more prominence to a detail, such as a tuberosity on a bone, which will never be referred to again in the

student's life, as to some vital point like the centre of respiration⁷.'

Today Abrahamson¹¹ shares this view. While agreeing with the shibboleth 'Medical students must learn the basic sciences' he asks, 'what will our graduates have to be able to do that might require their learning this material?'. Indeed it is likely that, if Mackenzie were alive today, he would heartily agree with Abrahamson's comment that 'Departments organized according to discipline... tend to become instruments of the territorial imperative with regard to the curriculum'. Abrahamson also feels that sometimes interdepartmental committees in medical schools still play territorial politics.

In general practice Mackenzie realized that there was a major gap in his undergraduate education. Mackenzie did not receive a patient-centred undergraduate education. He found that

'Most of the patients had no physical signs, and often such physical signs as I detected had no seeming relationship to their complaints. The patients felt ill, or suffered from pain or other disagreeable sensation. These subjective symptoms had received but scant attention in our training and I was unable to appreciate them⁷.'

THE VOCATIONAL TRAINEE

After university, Mackenzie had a house appointment at the Edinburgh Royal Infirmary and in 1879, following a locum stint in Durham, he started work in Burnley. His mentor was Dr Briggs who gave him a room at the top of his house at 68 Bank Parade. Immediately he found his textbooks useless for understanding the health of the Burnley people; and buying a large medical encyclopaedia was not a help either. In his spare time Mackenzie set about working to know the meaning of the signs and symptoms he met with every day as they affected a patient's living. He was able to draw on the accumulated experience of Dr Briggs for two learning objectives: first, an understanding of the mechanism of symptoms; and, second, an understanding of their prognostic significance². Mackenzie wrote:

'I had not long been in the practice when I discovered how defective was my knowledge. I left college under the impression that every patient's condition could be diagnosed. For a long time I strove to make a diagnosis and assiduously studied my lectures and text books, without avail... for some years I thought that this inability to diagnose my patients' complaints was due to personal defects, but gradually through consultations and

other ways, I came to realise that the kind of information I wanted did not exist¹.'

Murdoch¹² calls this 'Mackenzie's Puzzle'. He feels that today in our medical schools the mismatch between what the books say and what the patients feel can go unrecognized by teachers, and as a result family physicians, residents and students can find themselves in a state of blundering similar to that experienced by Mackenzie.

McWhinney¹³ comments on this by saying:

'A student who learns clinical problem solving in a tertiary care hospital will tend to have a frame of reference appropriate for patients with serious and well defined diseases in their later stages. If a student uses this frame of reference for solving problems in family practice, he or she will get into difficulties, the kind of difficulties described so well by James Mackenzie many years ago.'

Much of his research was done when he was in practice at Burnley in North West England from 1879 to 1902. Burnley was a mill town engaged in the manufacture of cotton. The year Mackenzie arrived 56 townspeople died from scarlet fever and in 1883 the infant mortality rate was 205 per 1000 live births¹. Rheumatic fever was common and Mackenzie heard many mitral valve murmurs in his patients.

THE SELF-DIRECTED LEARNER AND CONTINUING MEDICAL EDUCATION

Fate then intervened on his fertile mind. When he lost a young patient who died in labour from heart failure, Mackenzie resolved to research heart disease. He decided to study the venous pulse (in the neck) as well as the apex beat or arterial pulse. Mackenzie today would have criticized any approach to continuing medical education for general practitioners which had a tendency to cater for low levels of self-directed learning (SDRL). Those with low levels of SDRL look for external direction and didactic teaching, while those with high levels respond to facilitation but want to learn autonomously¹⁴. Mackenzie put his autonomous learning style to good use and recorded:

'... after much labour I hit upon a plan almost ridiculous in its simplicity. This method consists of placing a hollow lead cone or funnel (called a 'receiver') over any pulsating part where the surface of the skin permits the cavity of the funnel to be hermetically closed. This receiver is connected by means of an India rubber tube to a Marey's tambour and lever, the latter of which can be made to write on the smoked paper of a Dudgeon's

sphygmograph or revolving cylinder. The advantage of this method is enhanced by the fact that several such receivers can be used to take tracings at one and the same time of heart beat and of arterial, or venous pulse¹.

In 1892 a further development of this phlebograph was made and Mackenzie called it his clinical polygraph. This is illustrated in his book *The Study of the Pulse, Arterial, Venous and Hepatic and the Movements of the Heart*¹⁵, which was his first publication after 20 years of general practice research.

Using this new instrument Mackenzie studied an immense number of tracings and applied them to symptoms and signs of patients with heart problems. His first discovery was in a patient with missed heart beats. With simultaneous recordings of pulse and neck vessels he noticed that, at the moment the beat was to be missed, the left ventricle had contracted too soon whereas the auricle maintained its normal rhythm. He invented the term 'extra systole' and called the pulse the irregular pulse of the adult type. The tracing is recorded in his book *The Pulse*¹⁵. No one believed him but he persisted with his research. He said, 'not withstanding the complete indifference with which my work was viewed, I knew that I was getting at the truth'². Mackenzie kept tracings (varnished after being recorded on a smoked drum) and found that the patients were all alive and in active work six years further on. With tracings and fifteen to twenty years of observation he described what he called the 'youthful type of irregularity'² which we now know as sinus arrhythmias. At the time patients exhibiting this arrhythmia were confined to bed for months and Mackenzie proved the pointlessness of such an approach.

The reasoning of Mackenzie is evident in his account of 'paralysis of the auricle' and the murmur of mitral stenosis. In the relevant chapter of *The Pulse* he wrote:

'...in all the cases when there is only a ventricular venous pulse, I have never heard a presystolic murmur...even when at the post mortem examination well marked mitral stenosis was present. Thus in 1894 in taking a tracing of the slow pulse in Fig 218, I scratched the tracing indicating that there was a systolic murmur and a long murmur during the pause in the pulse. After death there was found marked mitral stenosis. In 1899 I came across an exactly similar case... The explanation then dawned on me. First there was no presystolic murmur, meaning thereby auricular systolic, even though there was marked mitral stenosis, because the auricle was incapable of contracting. Second the long diastolic murmur was evidently due to the onrush of blood from the dilated paralysed auricle through the mitral orifice during the ventricular diastole.'

In 'paralysis of the auricles', Mackenzie noted that, when the ventricles contracted, the jugular veins bulged instead of collapsing. Also the pulse was irregular and no two beats were the same. Though Mackenzie long insisted on the term paralysis rather than fibrillation, he did note the potency of digitalis in slowing the ventricular rate and relieving heart failure:

'...so long as the heart beat at a rate under 80 these patients were pretty well; whereas when the rate exceeded 100, they gradually showed increasing signs of heart failure. I therefore tried in each case to keep the heart in check with digitalis and was frequently able to regulate the dose to that amount which kept the rate under 80 and thus enabled the patients to pursue their occupations for years, though at a lower level than in health¹⁶.'

Later Lewis applied the Einthoven string galvanometer to Mackenzie's patients with auricular paralysis and found the p wave missing.

Mackenzie was also able to infer that in certain conditions the auricle and ventricle would beat simultaneously^{17,18} and that, when the ventricular venous pulse was present, contraction occurred from fibres joining auricle and ventricle.

Today Mackenzie would have been regarded as a good 'triple jumper'. The triple jump¹⁹ is a strategy for assessing process in problem-based curricula. The student is asked to think about a problem and to consider hypotheses; then devises a suitable experimental test; and finally re-evaluates the original hypothesis and the experimental tests on the basis of the new information supplied. The student is then assessed on problem-solving skills, self-directed learning skills and knowledge of the problem area. Mackenzie's triple jumping would have scored well and would have been judged valid, applying as it did to several problems, thus avoiding content specificity²⁰.

He fought for his ideas in London and became a respected teacher and consultant. Unlike Jenner 100 years before, he was elected a member of the Royal College of Physicians and received a knighthood.

At 65 Mackenzie returned to general practice at St Andrews in Scotland. Here he lectured, worked on general practice research and revised his book *Diseases of the Heart*. To the end, Mackenzie preached that the specialist who concentrated on diagnosing and treating one organ was at a disadvantage. The true 'science of medicine', as he delighted to call it, must be based on clinical observation of the whole person. A research worker once explained to Mackenzie that he was not sure, from his studies of the web of a frog's foot under a microscope, whether or not the small blood vessels of the skin were under nervous control

'one can see the blood moving in the small vessels of the web' he explained. Mackenzie nodded and added, 'one can also see a girl blushing when the name of her lover is mentioned'². Another example of patient-centredness can be gleaned from the statement:

'When it happens that the abnormal manifestation indicates that there is something wrong with the heart, the question may be more clearly realised by asking what it is the patient fears²¹.'

Mackenzie showed that, despite difficulty, it was possible to do serious research in general practice. Commenting on his book *The Pulse* a reviewer²² stated:

'... we often hear that in the bustle of general practice, scientific work is impossible... and it is almost pathetic to read in the preface 'I have seldom been able to give an uninterrupted hour's study to the subject... days and even weeks (have elapsed) before I have been able to resume it'¹¹.'

Before dying in 1925 Mackenzie experienced angina pectoris. He insisted that, on his death, colleagues should study his heart.

STILL A PROPHET?

Mackenzie strongly believed that the basic science of medicine is clinical observation. Here he was supported by Osler who felt that western medical schools were creating a scientific ethos that would impose itself between physician and patient. Mackenzie believed that general practice was the best place to learn the natural history of disease. According to McWhinney¹³, there is very little evidence that this example is being followed today. He feels it is rare to read a description of clinical observations made over a long period by the author himself. McWhinney feels that today's general practice research is the result of extracting data from other practitioners' records, and follow-up, if done, is for a short time. To wait ten years before publishing would earn few grants and little credit in medical school.

However, we are assuming that a modern-day Mackenzie would be a general practice academic. In fact, Mackenzie had a poor opinion of his undergraduate university and its failure to provide a deep learning experience for general practice. He did not know the politics of 'grantmanship'¹¹ and if he were alive today he would share Howie's concern that much academic general practice research is not regarded by real general practitioners as useful²³. His research would possibly be related to the general practice observation of chronic illness in patients over a long time and his education criticisms

directed towards any medical school that largely avoids studying 'patients in association with their natural environment and the stresses and strains of real life'⁶. In short, Mackenzie might not be welcome in some academic departments of general practice and would need to choose his university carefully.

Professor John Howie, of Edinburgh University's Department of General Practice, can trace his ancestry back to Mackenzie and has in his possession a script written by Mackenzie for his grandmother (Figure 2). In Howie's judgment²⁴ Mackenzie was right in declaring that medical teaching should start with the simple and that the complex then be easy, and general practice can make important contributions to research.

Mackenzie's close friend Sir Thomas Lewis wrote of him in his obituary:

'...he was an exceptionally vigorous and strong personality, intolerant of statements founded on tradition, trenchant and acute in criticism, rich in personal experience, combative in argument, but open never the less to conviction on all questions without reserve. He saw, as few or none of his day saw, where clinical knowledge ends and ignorance begins²⁵.'

Mackenzie's memory is perpetuated in the annual James Mackenzie lecture of the Royal College of General Practitioners and the Chair of General Practice at Edinburgh University. The Mackenzie Report into General Practice in the Medical Schools of the United Kingdom in 1986 was financed by the Mackenzie Fund²⁶, created from the residue of Mackenzie's estate.

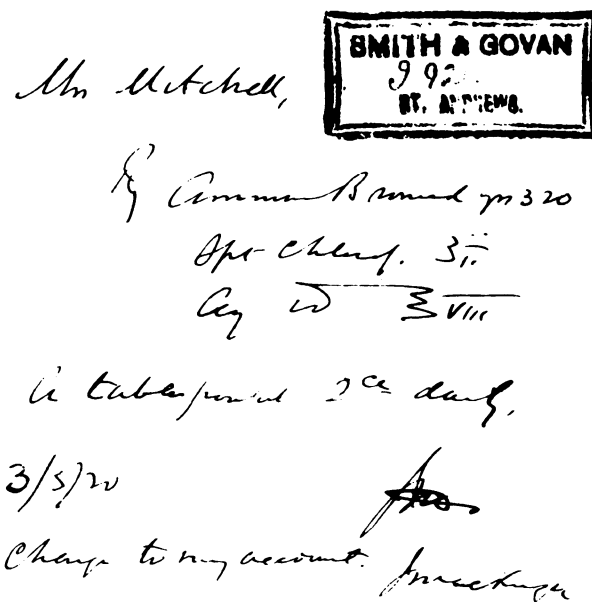


Figure 2 A script written by Sir James Mackenzie for Professor John Howie's grandmother

Mackenzie was typical of the 19th century masters of general practice. He had a rural background and was a scrupulous observer of patients. He persevered with his research despite initial rejection. He broke new frontiers of discovery by studying patients over long periods in their own environment. This ecological paradigm of medicine remains largely untapped today. He will also be remembered as one of the great visionaries of general practice and his criticisms of medical education still carry some weight today.

Acknowledgment I thank Professor John Howie for his support and for providing the copy of Mackenzie's script.

REFERENCES

- 1 Mair A. *Sir James Mackenzie MD 1853–1925, General Practitioner*. Edinburgh: Churchill Livingstone, 1973
- 2 McNair Wilson R. *The Beloved Physician. Sir James Mackenzie, a Biography*. London: John Murray 1926
- 3 Honey P, Mumford A. *The Manual of Learning Styles*. Maidenhead, 1992
- 4 Lewis AP, Bolden KJ. General practitioners and their learning styles. *J R Coll Gen Practit* 1989;**39**:187–9
- 5 Saunders N, Engel C, Feletti G. A clinical supervisor's rating form. *Med Teacher* 1982;**4**:151–4
- 6 Mackenzie J. The defects of medical practice, education and research. Inaugural address, Victoria Infirmary Glasgow. *Glasgow Med J* 1920;**94**:257
- 7 Mackenzie J. *The Future of Medicine*. London: Oxford University Press, 1919
- 8 Mackenzie J. The aim of medical education. *Edinb Med J* 1918;**20**:31–48
- 9 Howie J. The Edinburgh department of general practice. *Update* 1986;(October):597–604
- 10 Mackenzie J. The role of the general practitioner in the advancement of medical science. *Caledonian Med J* 1907;**5**:83
- 11 Abrahamson S. Six shibboleths of medical education. In: *Essays on Medical Education*. Lanham: University Press of America, 1996
- 12 Murdoch JC. Mackenzie's Puzzle—the cornerstone of teaching and research in general practice. *Br J Gen Pract* 1997;**47**:656–8
- 13 McWhinney IR. *A Textbook of Family Medicine*. New York: Oxford University Press, 1989
- 14 Burrows P. Self directed learning in general practice. *Educ Gen Pract* 1998;**9**:1–5
- 15 Mackenzie J. *The Study of the Pulse, Arterial, Venous and Hepatic and the Movements of the Heart*. Edinburgh & London: Young J Pentland, 1902
- 16 Mackenzie J. Action of digitalis on the human heart in cases where the inception of the rhythm of the heart is due to the ventricle. *BMJ* 1905;**i**:759
- 17 Mackenzie J. The inception of the rhythm of the heart by the ventricle. *BMJ* 1919;**i**:529
- 18 Mackenzie J. The interpretation of the pulsations of the jugular veins. *Am J Med Sci* 1907;**134**:12
- 19 Swanson DB, Case SM, van der Vlieten CP. Strategies for student assessment. In: Bond D, Felletti G, eds. *The Challenge of Problem-based Learning*. London: Kegan Page, p. 263
- 20 Swanson D, Norcini J, Grosso L. Assessment of clinical competence: written and computer-based simulations. *Assessment Eval Higher Educ* 1987;**12**:220–46
- 21 Mackenzie J. *Principles of Diagnosis and Treatment in Heart Affections*. London: Oxford University Press, 1916:38
- 22 Albutt J. Reviews: The Pulse. *BMJ* 1902;**ii**:250–1
- 23 Howie JG. Addressing the credibility gap in general practice research: better theory; more feeling; less strategy. *B J Gen Pract* 1996;**46**:479–81
- 24 Howie J. Quality of caring—landscapes and curtains. James Mackenzie lecture. *J R Coll Gen Practit* 1987;**34**:9
- 25 Lewis T. Sir James Mackenzie. *BMJ* 1925;**i**:245
- 26 Howie JGR, Hannay DR, Stevenson JSK. *The Mackenzie Report: General Practice in the Medical Schools of the United Kingdom*. Edinburgh: MacDonald Printers, 1986